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90 DEGREES PHASE SHIFTER
(PS/RF-HC 3187)

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1. CIRCUIT DESCRIPTION

The 90 degrees phase shifter schematic diagram is shown in figure 1.1.

The input rf signal is applied to the input buffer (Q1) which provides adequate separation from the input and the all-pass network composed of C16, C17 and Q3, Q4.

The all-pass network differential output is applied to IC1 which amplifies it to the required output level before getting to the output buffer Q2 - P1 allows exact adjustment of the output level.

The phase shift introduced by the all-pass network depends on the equivalent resistance of the two mosfets Q3, Q4 which are operated at rf voltages below the clamping level of their internal reverse diode so as to prevent distortion.

The equivalent resistance of Q3, Q4 will depend on the gate-source control voltage and threshold compensation can be independently adjusted by means of P2 and P3.

After phase difference detection of the input and output signals, performed by rf multiplication (IC2) followed by adequate filtering of the harmonic components, the error voltage is amplified by IC3 and applied to the gates of Q3, Q4 to obtain the phase loop which insures the desired dephasing.

For 90 degrees phase difference the loop forces the output signal to be cos(ϕ) if the input is sin(ϕ) and fine adjustment is done by P4.

The loop gain is sensitive to the amplitude of the signals applied to the rf multiplier and the required input and output levels are +4 dBm (1 Vp-p).

Figure 1.1 - Circuit Schematic Diagram

2. TECHNICAL CHARACTERISTICS

The main characteristics of the circuit are listed and plotted below.

Table 2.1 - 90 Degrees Phase Shifter Specifications

Parameter	**Value**	**Units**
Frequency Bandwidth	0.4 to 20	MHz
Input Level	+4 +/- 2	dBm
Output Level	+4 +/- 1	dBm
In - Out Phase	90 +/- 1	deg

Figure 2.1 - Transfer Function

3. ADJUSTMENT

1	**Preliminary Control**
1.1	By visual inspection verify that the module does not present evident manufacture errors. Verify that the module has been properly cleaned. Preset the potentiometers as follows : P1 - 15 turns CCW P2, P3 - 15 turns CW P4 - 15 turns CCW then 6 turns CW

2	**Power Supplies Test**
2.1	Verify that +/-6V are present on IC1 pins 10 and 5 respectively.

3	**Transfer Function Measurement and Module Adjustment**
3.1	By means of the test set-up shown in figure 3.1 measure the transfer function with an input power of +4dBm. Adjust P2 and P3 to obtain a flat frequency response. Adjust P1 to obtain 0dB gain. Adjust P4 to obtain 90 degrees phase shift. Verify that changing the input level by +/- 2dBm the response remains within the specified limits. **Note : specification limits are given in table 2.1**

At the end of the procedure put a drop of paint on P1, P2, P3, P4 and label the module 'OK + DATE'.

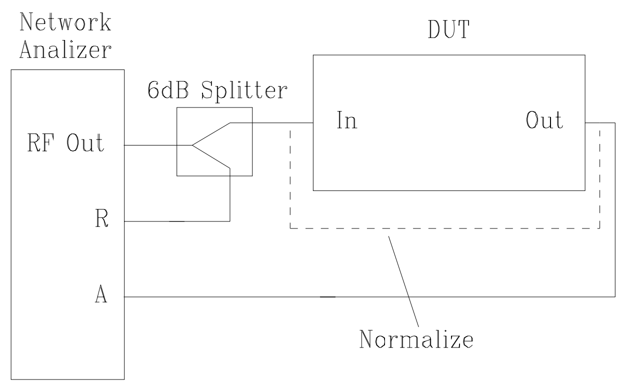

Figure 3.1 - Transfer Function Measurement Set-Up